CLAIMS

1 A thermoelectric semiconductor material produced by:

layering and packing plate shaped raw thermoelectric semiconductor materials made of a raw alloy having a predetermined composition of a thermoelectric semiconductor to form a layered body;

solidifying and forming the layered body to form a compact;

applying pressure to the compact in a uniaxial direction that is perpendicular or nearly perpendicular to a main layering direction of the raw thermoelectric semiconductor materials; and thereby

applying a shear force in a uniaxial direction that is approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials; and

plastically deforming the compact.

2. A thermoelectric semiconductor material having a compound phase comprising:

complex compound semiconductor phase having a predetermined stoichiometric composition of a compound thermoelectric semiconductor; and

a Te rich phase in which excess Te is added to the stoichiometric composition.

3. A thermoelectric semiconductor material produced by:

adding excess Te to a predetermined stoichiometric composition of a compound thermoelectric semiconductor to form a raw alloy;

layering and packing plate shaped raw thermoelectric semiconductor materials made of the raw alloy to form a layered body;

solidifying and forming the layered body to form a compact;

applying pressure to the compact in an axial direction perpendicular or nearly perpendicular to a main layering direction of the raw thermoelectric semiconductor

materials; and thereby

applying shear force in an axial direction approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials; and

plastically deforming the compact.

4. The thermoelectric semiconductor material according to Claim 2, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $(Bi\text{-}Sb)_2Te_3$ based composition.

5. The thermoelectric semiconductor material according to Claim 3, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $(Bi\text{-}Sb)_2Te_3$ based composition.

6. The thermoelectric semiconductor material according to Claim 2, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $Bi_2(Te\text{-}Se)_3$ based composition.

7. The thermoelectric semiconductor material according to Claim 3, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $Bi_2(Te\text{-}Se)_3$ based composition.

8. A thermoelectric semiconductor element produced by:

layering and packing plate shaped raw thermoelectric semiconductor materials made of a raw alloy having a predetermined composition of a thermoelectric semiconductor to form a layered body;

solidifying and forming the layered body to form a compact;

applying pressure to the compact in an axial direction perpendicular or approximately perpendicular to a main layering direction of the raw thermoelectric

semiconductor materials; and thereby

applying shear force in an axial direction approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials; and

plastically deforming the compact to form a thermoelectric semiconductor material;

cutting out a thermoelectric semiconductor element from the thermoelectric semiconductor material so that a plane approximately perpendicular to the uniaxial direction in which the shear force is applied during the plastic deformation of the compact can be used as a contact surface with an electrode.

9. The thermoelectric semiconductor element according to Claim 8 wherein the plate shaped raw thermoelectric semiconductor material have a compound phase comprising:

a complex compound semiconductor phase having a predetermined stoichiometric composition of a compound thermoelectric semiconductor; and

a Te rich phase including excess Te in the stoichiometric composition.

10. The thermoelectric semiconductor element according to Claim 9, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $(Bi\text{-}Sb)_2Te_3$ based composition.

11. The thermoelectric semiconductor element according to Claim 9, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $Bi_2(Te\text{-}Se)_3$ based composition.

12. A thermoelectric module comprising a PN element pair produced by:

layering and packing respectively plate shaped raw thermoelectric semiconductor materials made of a raw alloy comprising a composition of P type thermoelectric semiconductor, and plate shaped raw thermoelectric semiconductor materials made of a

raw alloy comprising a composition of N type thermoelectric semiconductor to form layered bodies;

solidifying and forming the layered bodies to form compacts;

applying pressure to the compacts having the compositions of P type and N type thermoelectric semiconductor in an axial direction perpendicular or approximately perpendicular to a main layering direction of the raw thermoelectric semiconductor materials; and thereby

applying shear force in an axial direction approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials; and

plastically deforming the compacts to form P type and N type thermoelectric semiconductor materials;

cutting out P type and N type thermoelectric semiconductor elements from the P type and N type thermoelectric semiconductor materials so that planes approximately perpendicular to the uniaxial direction in which the shear force is applied during the plastic deformation of the compacts can be used as contact surfaces with an electrode;

arranging the P type and N type thermoelectric semiconductor elements so that the elements are aligned in the direction perpendicular to the axial direction of pressure application during plastic deformation of the compacts, and also perpendicular to the direction of shear force by the pressure application;

joining the P type and N type elements via a metal electrode.

13. The thermoelectric module according to Claim 12, wherein the plate shaped P type and N type raw thermoelectric semiconductor materials respectively have a compound phase comprising:

complex compound semiconductor phase having a predetermined stoichiometric composition of a compound thermoelectric semiconductor; and

a Te rich phase in which excess Te is added to the stoichiometric composition.

14. The thermoelectric module according to Claim 13, wherein the stoichiometric composition of the P type compound thermoelectric semiconductor is a $(Bi\text{-}Sb)_2Te_3$ based composition.

15. A thermoelectric module according to Claim 13, wherein the stoichiometric composition of the N type compound thermoelectric semiconductor is a $Bi_2(Te\text{-}Se)_3$ based composition.

16. A manufacturing method for a thermoelectric semiconductor material comprising:

melting a raw alloy having a predetermined composition of a thermoelectric semiconductor;

having the raw alloy to be contacted with a surface of a cooling member to form plate shaped raw thermoelectric semiconductor materials;

layering and packing the plate shaped raw thermoelectric semiconductor materials to form a layered body;

solidifying and forming the layered body to form a compact;

applying pressure to the compact in one of two axial directions which are crossing each other in a plane approximately perpendicular to the main layering direction of the raw thermoelectric semiconductor materials, while preventing deformation of the compact in the other axial direction; and thereby

applying shear force in an axial direction approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials ; and

plastically deforming the compact to form a thermoelectric semiconductor material.

17. The manufacturing method for a thermoelectric semiconductor material according to Claim 16, wherein the raw alloy has a composition in which excess Te is added to a predetermined stoichiometric composition of a compound thermoelectric semiconductor.

18. The manufacturing method for a thermoelectric semiconductor material according to Claim 17, wherein the raw alloy comprises a composition in which 0.1 to 5% of excess Te is added to the stoichiometric composition of a compound thermoelectric semiconductor comprising 7 to 10 atomic % of Bi, 30 to 33 atomic % of Sb, and 60 atomic % of Te.

19. The manufacturing method for a thermoelectric semiconductor material according to Claim 17, wherein the raw alloy comprises a composition in which 0.01 to 10% of excess Te is added to the stoichiometric composition of a compound thermoelectric semiconductor comprising 40 atomic % of Bi, 50 to 59 atomic % of Te, and 1 to 10 atomic % of Se.

20. The manufacturing method for a thermoelectric semiconductor material according to Claim 17, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

21. The manufacturing method for a thermoelectric semiconductor material according to Claim 18, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

22. The manufacturing method for a thermoelectric semiconductor material according to Claim 19, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

23. The manufacturing method for a thermoelectric semiconductor material according to Claim 16, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

24. The manufacturing method for a thermoelectric semiconductor material according to Claim 17, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

25. The manufacturing method for a thermoelectric semiconductor material according to Claim 18, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

26. The manufacturing method for a thermoelectric semiconductor material according to Claim 19, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

27. The manufacturing method for a thermoelectric semiconductor material according to Claim 20, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the

formed plate shaped raw thermoelectric semiconductor material is not quenched.

28. The manufacturing method for a thermoelectric semiconductor material according to Claim 21, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

29. The manufacturing method for a thermoelectric semiconductor material according to Claim 22, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

30. The manufacturing method for a thermoelectric semiconductor material according to Claim 16, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

31. The manufacturing method for a thermoelectric semiconductor material according to Claim 17, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

32. The manufacturing method for a thermoelectric semiconductor material according to Claim 18, wherein a rotational roll is used as the cooling member and is rotated at a rate

at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

33. The manufacturing method for a thermoelectric semiconductor material according to Claim 19, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

34. The manufacturing method for a thermoelectric semiconductor material according to Claim 20, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

35. The manufacturing method for a thermoelectric semiconductor material according to Claim 21, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

36. The manufacturing method for a thermoelectric semiconductor material according to Claim 22, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

37. A manufacturing method for a thermoelectric semiconductor element, comprising:

melting a raw alloy having a predetermined composition of a thermoelectric semiconductor;

having the raw alloy to be contacted with a surface of a cooling member to form plate shaped raw thermoelectric semiconductor materials;

layering and packing in approximately layered form the plate shaped raw thermoelectric semiconductor materials to form a layered body;

solidifying and forming the layered body to form a compact;

applying pressure to the compact in one of two axial directions which are crossing each other in a plane approximately perpendicular to the main layering direction of the raw thermoelectric semiconductor materials, while preventing deformation of the compact in the other axial direction; and thereby

applying shear force in an axial direction approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials; and

plastically deforming the compact to form a thermoelectric semiconductor material; and

cutting out a thermoelectric semiconductor element from the thermoelectric semiconductor material so that a plane approximately perpendicular to the uniaxial direction in which the shear force is applied during the plastic deformation of the compact can be used as a contact surface with an electrode.

38. The manufacturing method for a thermoelectric semiconductor element according to Claim 37, wherein the raw alloy has a composition in which excess Te is added to a predetermined stoichiometric composition of a compound thermoelectric semiconductor.

39. The manufacturing method for a thermoelectric semiconductor element according to Claim 38, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $(Bi\text{-}Sb)_2Te_3$ based composition.

40. The manufacturing method for a thermoelectric semiconductor element according to Claim 39, wherein the raw alloy comprises a composition in which 0.1 to 5% of excess Te is added to the stoichiometric composition of a compound thermoelectric semiconductor comprising 7 to 10 atomic % of Bi, 30 to 33 atomic % of Sb, and 60 atomic % of Te.

41. The manufacturing method for a thermoelectric semiconductor element according to Claim 38, wherein the stoichiometric composition of the compound thermoelectric semiconductor is a $Bi_2(Te\text{-}Se)_3$ based composition.

42. The manufacturing method for a thermoelectric semiconductor element according to Claim 41, wherein the raw alloy comprises a composition in which 0.01 to 10% of excess Te is added to the stoichiometric composition of a compound thermoelectric semiconductor comprising 40 atomic % of Bi, 50 to 59 atomic % of Te, and 1 to 10 atomic % of Se.

43. The manufacturing method for a thermoelectric semiconductor element according to Claim 37, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

44. The manufacturing method for a thermoelectric semiconductor element according to Claim 38, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

45. The manufacturing method for a thermoelectric semiconductor element according

to Claim 39, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

46. The manufacturing method for a thermoelectric semiconductor element according to Claim 40, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

47. The manufacturing method for a thermoelectric semiconductor element according to Claim 41, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

48. The manufacturing method for a thermoelectric semiconductor element according to Claim 42, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

49. The manufacturing method for a thermoelectric semiconductor element according to Claim 37, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

50. The manufacturing method for a thermoelectric semiconductor element according to Claim 38, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the

molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

51. The manufacturing method for a thermoelectric semiconductor element according to Claim 39, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

52. The manufacturing method for a thermoelectric semiconductor element according to Claim 40, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

53. The manufacturing method for a thermoelectric semiconductor element according to Claim 41, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

54. The manufacturing method for a thermoelectric semiconductor element according to Claim 42, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

55. The manufacturing method for a thermoelectric semiconductor element according

to Claim 43, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

56. The manufacturing method for a thermoelectric semiconductor element according to Claim 44, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

57. The manufacturing method for a thermoelectric semiconductor element according to Claim 45, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

58. The manufacturing method for a thermoelectric semiconductor element according to Claim 46, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

59. The manufacturing method for a thermoelectric semiconductor element according to Claim 47, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

60. The manufacturing method for a thermoelectric semiconductor element according to Claim 48, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

61. The manufacturing method for a thermoelectric semiconductor element according to Claim 37, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

62. The manufacturing method for a thermoelectric semiconductor element according to Claim 38, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

63. The manufacturing method for a thermoelectric semiconductor element according to Claim 39, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

64. The manufacturing method for a thermoelectric semiconductor element according to Claim 40, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed

by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

65. The manufacturing method for a thermoelectric semiconductor element according to Claim 41, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

66. The manufacturing method for a thermoelectric semiconductor element according to Claim 42, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

67. The manufacturing method for a thermoelectric semiconductor element according to Claim 43, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

68. The manufacturing method for a thermoelectric semiconductor element according to Claim 44, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

69. The manufacturing method for a thermoelectric semiconductor element according

to Claim 45, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

70. The manufacturing method for a thermoelectric semiconductor element according to Claim 46, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

71. The manufacturing method for a thermoelectric semiconductor element according to Claim 47, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

72. The manufacturing method for a thermoelectric semiconductor element according to Claim 48, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

73. A manufacturing method for a thermoelectric module comprising:

melting a raw alloy having a composition of P type thermoelectric semiconductor, and a raw alloy having a composition of N type thermoelectric semiconductor respectively;

having the each raw alloy to be contacted with a surface of a cooling member to

form plate shaped raw thermoelectric semiconductor materials having a composition of P type thermoelectric semiconductor and plate shaped raw thermoelectric semiconductor materials having a composition of N type thermoelectric semiconductor respectively;

having the P type and N type raw thermoelectric semiconductor materials layered approximately parallel in a direction of plate thickness to form layered bodies;

solidifying and forming the layered bodies to form compacts;

applying pressure to each of the compacts having the compositions of P type and N type thermoelectric semiconductor in one of two axial directions which are crossing each other in a plane approximately perpendicular to the main layering direction of the raw thermoelectric semiconductor materials, while preventing deformation of the compact in the other axial direction; and thereby

applying shear force in an axial direction approximately parallel to the main layering direction of the raw thermoelectric semiconductor materials ; and

plastically deforming the compacts to form P type and N type thermoelectric semiconductor materials;

cutting out P type and N type thermoelectric semiconductor elements from the P type and N type thermoelectric semiconductor materials so that a plane approximately perpendicular to the uniaxial direction in which the shear force is applied during the plastic deformation of the compact can be used as a contact surface with an electrode;

arranging the P type and N type thermoelectric semiconductor elements so that the elements are aligned in the direction perpendicular to the axial direction of pressure application during plastic deformation of a compact, and also perpendicular to the direction of shear force by the pressure application;

joining the P type and N type elements via a metal electrode to form a PN element pair.

74. The manufacturing method for a thermoelectric module according to Claim 73, wherein the raw alloy of each of the P type and N type thermoelectric semiconductors has

a composition in which excess Te is added to a predetermined stoichiometric composition of a compound thermoelectric semiconductor.

75. The manufacturing method for a thermoelectric module according to Claim 74, wherein the stoichiometric composition of the P type compound thermoelectric semiconductor is a $(Bi\text{-}Sb)_2Te_3$ based composition.

76. The manufacturing method for a thermoelectric module according to Claim 75, wherein the raw alloy of the P type thermoelectric semiconductor comprises a composition in which 0.1 to 5% of excess Te is added to the stoichiometric composition of a compound thermoelectric semiconductor comprising 7 to 10 atomic % of Bi, 30 to 33 atomic % of Sb, and 60 atomic % of Te.

77. The manufacturing method for a thermoelectric module according to Claim 74, wherein the stoichiometric composition of the N type compound thermoelectric semiconductor is a $Bi_2(Te\text{-}Se)_3$ based composition.

78. The manufacturing method for a thermoelectric module according to Claim 77, wherein the raw alloy of the N type thermoelectric semiconductor wherein the raw alloy comprises a composition in which 0.01 to 10% of excess Te is added to the stoichiometric composition of a compound thermoelectric semiconductor comprising 40 atomic % of Bi, 50 to 59 atomic % of Te, and 1 to 10 atomic % of Se.

79. The manufacturing method for a thermoelectric module according to Claim 74, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

80. The manufacturing method for a thermoelectric module according to Claim 75, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

81. The manufacturing method for a thermoelectric module according to Claim 76, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

82. The manufacturing method for a thermoelectric module according to Claim 77, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

83. The manufacturing method for a thermoelectric module according to Claim 78, wherein solidification forming of the raw thermoelectric semiconductor materials is carried out by: along with applying pressure; heating the raw material at a temperature no lower than 380°C and no higher than 500°C.

84. The manufacturing method for a thermoelectric module according to Claim 73, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

85. The manufacturing method for a thermoelectric module according to Claim 74, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as

to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

86. The manufacturing method for a thermoelectric module according to Claim 75, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

87. The manufacturing method for a thermoelectric module according to Claim 76, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

88. The manufacturing method for a thermoelectric module according to Claim 77, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

89. The manufacturing method for a thermoelectric module according to Claim 78, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

90. The manufacturing method for a thermoelectric module according to Claim 79, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

91. The manufacturing method for a thermoelectric module according to Claim 80, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

92. The manufacturing method for a thermoelectric module according to Claim 81, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

93. The manufacturing method for a thermoelectric module according to Claim 82, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate shaped raw thermoelectric semiconductor material is not quenched.

94. The manufacturing method for a thermoelectric module according to Claim 83, wherein, when the molten raw alloy is contacted with a surface of a cooling member so as to form the plate shaped raw thermoelectric semiconductor materials, the molten alloy is cooled and solidified at a rate at which 90% or more of a thickness of the formed plate

shaped raw thermoelectric semiconductor material is not quenched.

95. The manufacturing method for a thermoelectric module according to Claim 73, wherein a rotational roll is used as the cooling member and is rotated at a rate at which the thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

96. The manufacturing method for a thermoelectric module according to Claim 74, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

97. The manufacturing method for a thermoelectric module according to Claim 75, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

98. The manufacturing method for a thermoelectric module according to Claim 76, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

99. The manufacturing method for a thermoelectric module according to Claim 77, wherein a rotational roll is used as the cooling member and is rotated at a rate at which

thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

100. The manufacturing method for a thermoelectric module according to Claim 78, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

101. The manufacturing method for a thermoelectric module according to Claim 79, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

102. The manufacturing method for a thermoelectric module according to Claim 80, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

103. The manufacturing method for a thermoelectric module according to Claim 81, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

104. The manufacturing method for a thermoelectric module according to Claim 82, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

105. The manufacturing method for a thermoelectric module according to Claim 83, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

106. The manufacturing method for a thermoelectric module according to Claim 84, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

107. The manufacturing method for a thermoelectric module according to Claim 85, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

108. The manufacturing method for a thermoelectric module according to Claim 86, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and

solidifying the molten alloy is at least 30 μm or greater.

109. The manufacturing method for a thermoelectric module according to Claim 87, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

110. The manufacturing method for a thermoelectric module according to Claim 88, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

111. The manufacturing method for a thermoelectric module according to Claim 89, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

112. The manufacturing method for a thermoelectric module according to Claim 90, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

113. The manufacturing method for a thermoelectric module according to Claim 91, wherein a rotational roll is used as the cooling member and is rotated at a rate at which

thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

114. The manufacturing method for a thermoelectric module according to Claim 92, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

115. The manufacturing method for a thermoelectric module according to Claim 93, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.

116. The manufacturing method for a thermoelectric module according to Claim 94, wherein a rotational roll is used as the cooling member and is rotated at a rate at which thickness of the plate shaped raw thermoelectric semiconductor material formed by supplying the molten raw alloy to the surface of the cooling member and cooling and solidifying the molten alloy is at least 30 μm or greater.